

**What is claimed is:**

1           1. A method for protecting a MEMS structure during a dicing of a MEMS wafer to  
2 produce individual MEMS dies, comprising the steps of:

3           (a) preparing a MEMS wafer having a plurality of MEMS structure sites on a first side  
4 and a plurality of through holes on a second side;

5           (b) mounting, upon the first side of the MEMS wafer, a wafer cap to produce a laminated  
6 MEMS wafer, the wafer cap being recessed in areas corresponding to locations of the MEMS  
7 structure sites on the MEMS wafer;

8           (c) mounting, upon the second side of the MEMS wafer, a layer of dicing tape; and

9           (d) dicing the laminated MEMS wafer into a plurality of MEMS dies.

1           2. The method as claimed in claim 1, wherein the laminated MEMS wafer is diced using  
2 a saw.

1           3. The method as claimed in claim 1, wherein the layer of dicing tape has a UV  
2 releasable adhesive.

1           4. The method as claimed in claim 1, wherein the layer of dicing tape is heat shrinkable.

1           5. The method as claimed in claim 1, wherein the layer of dicing tape has a UV  
2 releasable adhesive and the layer of dicing tape is heat shrinkable.

1           6. The method as claimed in claim 1, wherein the wafer cap is a cover tape with an  
2 adhesive medium.

1           7. The method as claimed in claim 1, wherein the wafer cap includes an adhesive  
2 medium.

1           8. The method as claimed in claim 7, wherein the adhesive medium is an ultraviolet light  
2 releasable medium.

1           9. The method as claimed in claim 7, wherein the adhesive medium is a heat releasable  
2 medium.





4 cover coming into physical contact with the MEMS wafer and to prevent electrostatically  
5 induced damage to the MEMS wafer.

1 34. The method as claimed in claim 1, wherein the laminated MEMS wafer is diced with  
2 a wafer saw with a dicing tape side of the laminated MEMS wafer facing towards a cutting  
3 device of the wafer saw such that the layer of dicing tape is sawn before the MEMS wafer.

1 35. A method for protecting a MEMS structure during a production of individual MEMS  
2 dies, comprising the steps of:

3 (a) fabricating a MEMS wafer having a plurality of MEMS structure sites on a first side  
4 and a plurality of through holes on a second side;

5 (b) fabricating a wafer cap;

6 (c) bonding the wafer cap to the first side of the MEMS wafer to produce a laminated  
7 MEMS wafer, the wafer cap being recessed in areas corresponding to locations of the MEMS  
8 structure sites on the MEMS wafer;

9 (d) mounting, upon the second side of the MEMS wafer, a layer of dicing tape; and

10 (e) dicing the second side of the laminated MEMS wafer into a plurality of MEMS dies.

1 36. The method as claimed in claim 35, further comprising the steps of:

2 (f) removing the wafer cap from the laminated MEMS wafer; and

3 (g) removing individual dies from the diced laminated MEMS wafer before the wafer cap  
4 is removed from the laminated MEMS wafer.

1 37. The method as claimed in claim 35, further comprising the steps of:

2 (f) removing the wafer cap from the laminated MEMS wafer;

3 (g) removing individual dies from the diced laminated MEMS wafer; and

4 (h) mounting dies from the diced laminated MEMS wafer into a package before the wafer  
5 cap is removed from the laminated MEMS wafer.

1 38. The method as claimed in claim 35, further comprising the steps of:

2 (f) removing the wafer cap and the layer of dicing tape from the laminated MEMS wafer;

3 (g) removing individual dies from the diced laminated MEMS wafer; and

4 (h) mounting dies from the diced laminated MEMS wafer into a package after the wafer  
5 cap is removed from the laminated MEMS wafer.

1 39. The method as claimed in claim 35, wherein the laminated MEMS wafer is  
2 diced using a saw.

1 40. The method as claimed in claim 35, wherein the layer of dicing tape has a UV  
2 releasable adhesive.

1 41. The method as claimed in claim 35, wherein the layer of dicing tape is heat  
2 shrinkable.

1 42. The method as claimed in claim 35, wherein the layer of dicing tape has a UV  
2 releasable adhesive and the layer of dicing tape is heat shrinkable.

1 43. The method as claimed in claim 35, wherein the wafer cap is a cover tape with an  
2 adhesive medium.

1 44. The method as claimed in claim 35, wherein the wafer cap includes an adhesive  
2 medium.

1 45. The method as claimed in claim 44, wherein the adhesive medium is an ultraviolet light  
2 releasable medium.

1 46. The method as claimed in claim 44, wherein the adhesive medium is a heat  
2 releasable medium.

1 47. The method as claimed in claim 44, wherein the adhesive medium is a combination  
2 of an ultraviolet light and heat releasable medium.

1 48. The method as claimed in claim 44, wherein the adhesive medium comprises a  
2 thermoplastic organic material.

1 49. The method as claimed in claim 44, wherein the adhesive medium comprises an  
2 ultraviolet light sensitive organic material.

1 50. The method as claimed in claim 35, wherein the layer of dicing tape is applied to a  
2 second side of the MEMS wafer after the wafer cap is mounted on the MEMS wafer.

1 51. The method as claimed in claim 35, wherein the layer of dicing tape is applied to a  
2 second side of the MEMS wafer before the wafer cap is mounted on the MEMS wafer.



1           65. The method as claimed in claim 56, wherein the spacer layer comprises a plurality of  
2 layers of perforated tape, an aggregate of the plurality of layers of perforated tape producing the  
3 height to prevent damage to the MEMS structures due to the wafer cover coming into physical  
4 contact with the MEMS wafer.

1           66. The method as claimed in claim 56, wherein the spacer layer comprises a plurality of  
2 layers of perforated tape, an aggregate of the plurality of layers of perforated tape producing the  
3 height to prevent electrostatically induced damage to the MEMS wafer.

1           67. The method as claimed in claim 56, wherein the spacer layer comprises a plurality of  
2 layers of perforated tape, an aggregate of the plurality of layers of perforated tape producing the  
3 height to prevent damage to the MEMS structures due to the wafer cover coming into physical  
4 contact with the MEMS wafer and to prevent electrostatically induced damage to the MEMS  
5 wafer.

1           68. The method as claimed in claim 35, wherein the laminated MEMS wafer is diced  
2 with a wafer saw with a dicing tape side of the laminated MEMS wafer facing towards a cutting  
3 device of the wafer saw such that the layer of dicing tape is sawn before the MEMS wafer.

1           69. A laminated MEMS wafer, comprising:  
2 a MEMS wafer having a plurality of MEMS structure sites located on a first side and a  
3 plurality of through holes located on a second side;  
4 a removable wafer cap; and  
5 a layer of dicing tape mounted upon the second side of the MEMS wafer;  
6 said removable wafer cap being bonded to the first side of the MEMS wafer to  
7 produce a laminated MEMS wafer, the wafer cap being recessed in areas corresponding to  
8 locations of the MEMS structure sites on the MEMS wafer.

1           70. The laminated MEMS wafer as claimed in claim 69, wherein said layer of dicing  
2 tape has a UV releasable adhesive.

1           71. The laminated MEMS wafer as claimed in claim 69, wherein said layer of dicing  
2 tape is heat shrinkable.

1           72. The laminated MEMS wafer as claimed in claim 69, wherein said layer of dicing  
2 tape has a UV releasable adhesive and the layer of dicing tape is heat shrinkable.

1 73. The laminated MEMS wafer as claimed in claim 69, wherein said removable wafer  
2 cap is a cover tape with an adhesive medium.

1 74. The laminated MEMS wafer as claimed in claim 69, wherein said removable wafer  
2 cap includes an adhesive medium.

1 75. The laminated MEMS wafer as claimed in claim 74, wherein the adhesive medium is  
2 an ultraviolet light releasable medium.

1 76. The laminated MEMS wafer as claimed in claim 74, wherein the adhesive medium is  
2 a heat releasable medium.

1 77. The laminated MEMS wafer as claimed in claim 74, wherein the adhesive medium is  
2 a combination of an ultraviolet light and heat releasable medium.

1 78. The laminated MEMS wafer as claimed in claim 74, wherein the adhesive medium  
2 comprises a thermoplastic organic material.

1 79. The laminated MEMS wafer as claimed in claim 74, wherein the adhesive medium  
2 comprises an ultraviolet light sensitive organic material.

1 80. The laminated MEMS wafer as claimed in claim 69, wherein said layer of dicing  
2 tape is applied to a second side of the MEMS wafer after said removable wafer cap is mounted  
3 on the MEMS wafer.

1 81. The laminated MEMS wafer as claimed in claim 69, wherein said layer of dicing  
2 tape is applied to a second side of the MEMS wafer before said removable wafer cap is mounted  
3 on the MEMS wafer.

1 82. The laminated MEMS wafer as claimed in claim 69, wherein said removable wafer  
2 cap comprises silicon-based material.

1 83. The laminated MEMS wafer as claimed in claim 69, wherein said removable wafer  
2 cap comprises a glass-based material.

1 84. The laminated MEMS wafer as claimed in claim 69, wherein said removable wafer  
2 cap comprises a ceramic-based material.



1 85. The laminated MEMS wafer as claimed in claim 69, wherein said removable wafer  
2 cap comprises a polymer-based material.

1 86. The laminated MEMS wafer as claimed in claim 69, wherein said removable wafer  
2 cap comprises a wafer cover and a spacer layer.

1 87. The laminated MEMS wafer as claimed in claim 86, wherein said spacer layer  
2 comprises a tape having adhesive on two sides and a flexible film.

1 88. The laminated MEMS wafer as claimed in claim 86, wherein said spacer layer  
2 comprises a flexible film with an adhesive medium on one side.

1 89. The laminated MEMS wafer as claimed in claim 87, wherein said flexible film is  
2 transmissive to UV radiation.

1 90. The laminated MEMS wafer as claimed in claim 88, wherein said flexible film is  
2 transmissive to UV radiation.

1 91. The laminated MEMS wafer as claimed in claim 86, wherein said wafer cover is a  
2 cover tape.

1 92. The laminated MEMS wafer as claimed in 86, wherein a height of said spacer layer  
2 prevents said wafer cover from deflecting in such a manner to come in contact with the MEMS  
3 structures.

1 93. The laminated MEMS wafer as claimed in 86, wherein a height of said spacer layer  
2 prevents electrostatically induced damage to said MEMS wafer.

1 94. The laminated MEMS wafer as claimed in 86, wherein a height of said spacer layer  
2 prevents electrostatically induced damage to said MEMS wafer and prevents said wafer cover  
3 from deflecting in such a manner to come in contact with the MEMS structures.

1 95. The laminated MEMS wafer as claimed in claim 86, wherein said spacer layer  
2 comprises a plurality of layers of perforated tape, an aggregate of the plurality of layers of  
3 perforated tape producing the height to prevent damage to the MEMS structures due to said  
4 wafer cover coming into physical contact with the MEMS wafer.

1 96. The laminated MEMS wafer as claimed in claim 86, wherein said spacer layer  
2 comprises a plurality of layers of perforated tape, an aggregate of the plurality of layers of  
3 perforated tape producing the height to prevent electrostatically induced damage to said MEMS  
4 wafer.

1 97. The laminated MEMS wafer as claimed in claim 86, wherein said spacer layer  
2 comprises a plurality of layers of perforated tape, an aggregate of the plurality of layers of  
3 perforated tape producing the height to prevent damage to the MEMS structures due to said  
4 wafer cover coming into physical contact with the MEMS wafer and to prevent electrostatically  
5 induced damage to said MEMS wafer.

1 98. The laminated MEMS wafer as claimed in claim 69, wherein the laminated MEMS  
2 wafer is diced with a wafer saw with a dicing tape side of the laminated MEMS wafer facing  
3 towards a cutting device of the wafer saw such that said layer of dicing tape is sawn before said  
4 MEMS wafer.

1 99. The method as claimed in claim 2, wherein the layer of dicing tape is applied to a  
2 second side of the MEMS wafer after the laminated MEMS wafer is sawn.

1 100. The method as claimed in claim 1, wherein the wafer cap comprises a metal.

1 101. The method as claimed in claim 1, wherein the wafer cap comprises a static  
2 dissipative material.

1 102. The method as claimed in claim 1, wherein the dicing tape comprises a static  
2 dissipative material.

1 103. The method as claimed in claim 1, wherein the laminated MEMS wafer is diced  
2 with a wafer saw with a wafer cap side of the laminated MEMS wafer facing towards a cutting  
3 device of the wafer saw such that the wafer cap is sawn before the MEMS wafer.

1 104. The method as claimed in claim 3, wherein the layer of dicing tape is removed by  
2 exposing the dicing tape to UV radiation.

1 105. The method as claimed in claim 4, wherein the layer of dicing tape is removed by  
2 exposing the dicing tape to heat.

1 106. The method as claimed in claim 3, wherein the layer of dicing tape is removed by  
2 first exposing the dicing tape to UV radiation and then exposing the dicing tape to heat.

1 107. The method as claimed in claim 35, further comprising the steps of:

2 (f) removing the wafer cap from the laminated MEMS wafer; and

3 (g) removing the layer of dicing tape from the laminated MEMS wafer.

1 108. The method as claimed in claim 107, wherein the layer of dicing tape is removed by  
2 exposing the dicing tape to UV radiation.

1 109. The method as claimed in claim 107, wherein the layer of dicing tape is removed by  
2 exposing the dicing tape to heat.

1 110. The method as claimed in claim 107, wherein the layer of dicing tape is removed by  
2 first exposing the dicing tape to UV radiation and then exposing the dicing tape to heat.

1 111. The method as claimed in claim 1, further comprising the steps of:

2 (e) removing the layer of dicing tape from the second side of the MEMS wafer; and

3 (f) removing individual dies from the MEMS wafer.

1 112. The laminated MEMS wafer as claimed in claim 69, wherein said removable wafer  
2 cap comprises a metal.

1 113. The laminated MEMS wafer as claimed in claim 69, wherein said removable wafer  
2 cap comprises a static dissipative material.

1 114. The laminated MEMS wafer as claimed in claim 69, wherein said dicing tape  
2 comprises a static dissipative material.

1 115. A method for protecting a wafer during a dicing, comprising the steps of:

2 (a) mounting, upon a backside of a wafer, a layer of dicing tape, the wafer having a front  
3 patterned side and a plurality of etched ports on a backside, the etched ports providing a possible  
4 leak path from a backside of the wafer to the front patterned side of the wafer; and

5 (b) dicing the wafer into a plurality of dies.

1 116. The method as claimed in claim 115, wherein the wafer is diced using a saw.

1 117. The method as claimed in claim 115, wherein the layer of dicing tape has a UV  
2 releasable adhesive.

1 118. The method as claimed in claim 115, wherein the layer of dicing tape is heat  
2 shrinkable.

1 119. The method as claimed in claim 115, wherein the layer of dicing tape has a UV  
2 releasable adhesive and the layer of dicing tape is heat shrinkable.

1 120. The method as claimed in claim 115, further comprising the step of:  
2 (c) removing the layer of dicing tape from the wafer.

1 121. The method as claimed in claim 120, wherein the layer of dicing tape is removed by  
2 exposing the dicing tape to UV radiation.

1 122. The method as claimed in claim 120, wherein the layer of dicing tape is removed by  
2 exposing the dicing tape to heat.

1 123. The method as claimed in claim 120, wherein the layer of dicing tape is removed by  
2 first exposing the dicing tape to UV radiation and then exposing the dicing tape to heat.

1 124. A wafer, comprising:  
2 a wafer having a front patterned side and a plurality of etched ports on a backside, the  
3 etched ports providing a possible leak path from a backside of the wafer to the front patterned  
4 side of the wafer; and  
5 a layer of dicing tape mounted upon the backside of said wafer.

1 125. The laminated MEMS wafer as claimed in claim 124, wherein said layer of dicing  
2 tape has a UV releasable adhesive.

1 126. The laminated MEMS wafer as claimed in claim 124, wherein said layer of dicing  
2 tape is heat shrinkable.

1 127. The laminated MEMS wafer as claimed in claim 124, wherein said layer of dicing  
2 tape has a UV releasable adhesive and the layer of dicing tape is heat shrinkable.



1 141. The method as claimed in claim 128, wherein the perforated tape comprises a  
2 plurality of layers of perforated tape, an aggregate of the plurality of layers of perforated tape  
3 producing the height to prevent electrostatically induced damage.

1 142. The laminated MEMS wafer as claimed in claim 69, wherein said layer of dicing  
2 tape comprises a cover tape and a perforated tape.

1 143. The laminated MEMS wafer as claimed in claim 142, wherein said cover tape  
2 includes an adhesive medium.

1 144. The laminated MEMS wafer as claimed in claim 143, wherein the adhesive medium  
2 is an ultraviolet light releasable medium.

1 145. The laminated MEMS wafer as claimed in claim 143, wherein the adhesive medium  
2 is a heat releasable medium.

1 146. The laminated MEMS wafer as claimed in claim 143, wherein the adhesive medium  
2 is a combination of an ultraviolet light and heat releasable medium.

1 147. The laminated MEMS wafer as claimed in claim 143, wherein the adhesive medium  
2 comprises a thermoplastic organic material.

1 148. The laminated MEMS wafer as claimed in claim 143, wherein the adhesive medium  
2 comprises an ultraviolet light sensitive organic material.

1 149. The laminated MEMS wafer as claimed in claim 142, wherein said cover tape  
2 comprises a static dissipative material.

1 150. The laminated MEMS wafer as claimed in claim 142, wherein said perforated tape  
2 comprises a static dissipative material.

1 151. The laminated MEMS wafer as claimed in claim 142, wherein said perforated tape  
2 comprises a tape having adhesive on two sides and a flexible film.

1 152. The laminated MEMS wafer as claimed in claim 142, wherein said perforated tape  
2 comprises a flexible film with an adhesive medium on one side.

1           153. The laminated MEMS wafer as claimed in claim 151, wherein said flexible film is  
2 transmissive to UV radiation.

1           154. The laminated MEMS wafer as claimed in claim 152, wherein said flexible film is  
2 transmissive to UV radiation.

1           155. The laminated MEMS wafer as claimed in 142, wherein a height of said perforated  
2 tape prevents electrostatically induced damage.

1           156. The laminated MEMS wafer as claimed in claim 142, wherein said perforated tape  
2 comprises a plurality of layers of perforated tape, an aggregate of the plurality of layers of  
3 perforated tape producing the height to prevent electrostatically induced damage.